

THAT WHICH IS CLAIMED:

1. A method of forming a structural member having predetermined dimensions, the method comprising:
  - introducing particles of a structural material into a gas comprising hydrogen;
  - mixing the gas and particles to form a mixed stream having a temperature less
  - 5 than a melting temperature of the structural material;
  - directing the mixed stream of the gas and particles toward a base member such that the structural material is deposited on the base member, thereby forming a structural member; and
  - subjecting the structural member to a sub-atmospheric pressure, thereby
  - 10 releasing hydrogen from the structural material of the structural member.
2. A method according to Claim 1 further comprising providing the particles of the structural material, the particles being between about 1 and 50 microns in diameter.
3. A method according to Claim 1 further comprising heating the
- 15 particles to a temperature less than the melting temperature of the structural material.
4. A method according to Claim 1 further comprising providing the particles of the structural material, the particles comprising titanium.
5. A method according to Claim 1 further comprising providing the base member and the particles of the structural material, each of the base member and the
- 20 particles of the structural material comprising titanium.
6. A method according to Claim 1 further comprising providing the gas, the gas comprising at least about 99% hydrogen by weight.
7. A method according to Claim 1 wherein said mixing step comprises accelerating the gas and particles to a supersonic speed.
- 25 8. A method according to Claim 1 wherein said step of subjecting the structural member to a sub-atmospheric pressure comprises subjecting the structural member to a pressure less than about 0.0001 torr.

9. A method according to Claim 1 wherein said step of subjecting the structural member to a sub-atmospheric pressure comprises subjecting the structural member to the sub-atmospheric pressure for at least about 60 minutes.

5 10. A method according to Claim 1 further comprising heating the structural member in conjunction with said step of subjecting the structural member to a sub-atmospheric pressure.

11. A method according to Claim 1 further comprising removing the structural material from the base member.

10 12. A method according to Claim 1 further comprising forging the structural member and thereby shaping the structural member to the predetermined dimensions.

13. A method according to Claim 1 further comprising machining the structural member to the predetermined dimensions.

14. A structural member formed by the method of Claim 1.

15 15. A structural member according to Claim 14 wherein the structural member contains at least trace amounts of hydrogen.

16. A method of forming a preform for use in forming a structural member, the method comprising:

20 determining desired dimensions of the structural member;  
providing a base member according to the dimensions of the structural member;

spraying particles of a structural material on the base member such that the structural material is disposed on the base member to form the preform; and

25 plastically deforming the preform according to the dimensions of the structural member such that the preform has dimensions approximating the desired dimensions of the structural member.

17. A method according to Claim 16 further comprising processing the preform after said spraying step, wherein said processing step comprises a material treatment selected from the group consisting of hot isostatic pressing, heat treating, aging, quenching, stretching, annealing, and solution annealing.

5 18. A method according to Claim 16 wherein said spraying step comprises directing a stream of the particles in a gas comprising hydrogen, and further comprising subjecting the structural material to a sub-atmospheric pressure after said spraying step to thereby releasing hydrogen from the structural material.

10 19. A method according to Claim 16 further comprising providing the particles of the structural material, the particles comprising titanium.

20. A method according to Claim 16 wherein said spraying step comprises directing a mixed stream of gas and particles of the structural material toward the base member such that the structural material is deposited on the base member, the mixed stream having a temperature sufficiently low to prevent melting of the structural material.

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21. A method according to Claim 16 wherein said plastically deforming step comprises deforming at least the base member.

22. A method according to Claim 16 wherein said providing step comprises providing a mold corresponding to the dimensions of the structural member and further comprising removing the structural material from the base member after said spraying step such that the structural material comprises the preform.

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23. A method according to Claim 16 wherein said plastically deforming step comprises heating the preform.

24. A method according to Claim 16 wherein said plastically deforming step comprises urging the preform against a forming surface of at least one die and thereby forging the preform.

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25. A method according to Claim 16 wherein said plastically deforming step comprises refining the grain size of the preform.

26. A method of forming a preform for use in forming a structural member, the method comprising:

determining desired dimensions of the structural member;

5 providing a base member according to the dimensions of the structural member;

spraying particles of a structural material on the base member such that the structural material is disposed on the base member to form the preform; and

subjecting the preform to a sub-atmospheric pressure; and

10 subsequent to said subjecting step, cold isostatically pressing the preform to reduce a porosity of the preform.

27. A method according to Claim 26 further comprising substantially sealing the preform in a membrane before said cold isotatically pressing step.

28. A method according to Claim 26 further comprising:

15 providing hydrogen gas to the preform after said subjecting step such that the preform absorbs the hydrogen gas; and

subsequent to said cold isostatically pressing step, heating the preform and subjecting the preform to a sub-atmospheric pressure, thereby releasing hydrogen from the preform.

29. A method of forming a structural member, comprising:

determining desired dimensions of the structural member;

20 providing a base member according to the desired dimensions of the structural member;

25 spraying particles of a structural material on the base member such that the structural material is disposed on the base member to form the preform, the preform having dimensions approximating the desired dimensions of the structural member; and

thereafter, machining the preform to remove excess material from the preform to form the structural member having the predetermined desired dimensions.

30 30. A method according to Claim 29 further comprising processing the preform after said spraying step, wherein said processing step comprises a material

treatment selected from the group consisting of hot isostatic pressing, heat treating, aging, quenching, stretching, annealing, and solution annealing.

31. A method according to Claim 29 wherein said spraying step comprises directing a mixed stream of gas and particles of a structural material toward the base member such that the structural material is deposited on the base member, the mixed stream having a temperature sufficiently low to prevent melting of the structural material.

32. A method according to Claim 29 wherein said spraying step comprises directing a stream of the particles in a gas comprising hydrogen, and further comprising heating the preform and subjecting the preform to a sub-atmospheric pressure, thereby releasing hydrogen from the structural material of the structural member.

33. A preform for use in forming a machined structural member of predetermined dimensions, the preform comprising:  
a base member; and  
a structural material deposited on the base member by cold spraying, the structural material deposited on the base member containing hydrogen gas,  
wherein each of the base member and the structural material define at least one machinable portion configured to be machined to define the predetermined dimensions such that the base member and the structural material of the preform have dimensions approximating the dimensions of the machined structural member.

34. A preform according to Claim 33 wherein each of the base member and the structural material comprise material selected from the group consisting of aluminum, aluminum alloys, titanium, titanium alloys, nickel-based alloys, steel, copper-based alloys, and beryllium-based alloys.

35. A preform according to Claim 33 wherein each of the base member and the structural material comprise dissimilar materials.